Ultrastructural maintenance of decellularized corneas using dextran [abstract]

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Purpose

Corneal decellularization has emerged as a promising alternative to traditional tissue-engineering strategies for the creation of corneal replacements for transplantation. However, decellularization methods can lead to swelling of the cornea, limiting its potential use as a scaffold. In this study, we propose the use of a complex polysaccharide, dextran, to reduce this swelling and maintain the native dimensions and architecture of the cornea.

Methods

Porcine corneal buttons were treated with Triton X-100, SDS and nucleases under constant rotation followed by a washing step. To prevent corneal swelling, the decellularization solution was supplemented with dextran. This solution was added to one group throughout the decellularization process and to a second group during the washing cycle. The resulting acellular scaffolds were systematically evaluated by histological and biochemical analyses, in addition, the ultrastructure of the cornea was examined by transmission electron microscopy (TEM).

Results

Results demonstrated that the combination of detergents and nucleases effectively removed the majority of cellular material from the cornea. Furthermore, the addition of dextran prevented significant swelling when used throughout the protocol or only during the washing process. After soaking in glycerol a degree of transparency was returned to all decellularized corneas suggesting maintenance of the extracellular matrix. However, TEM analysis confirmed that dextran must be present throughout the decellularization process to preserve the native ultrastructure of the cornea.

Conclusions

The findings of this study indicate that the addition of dextran to the decellularization process not only prevents significant corneal swelling but also enhances the maintenance of the native ultrastructure of the cornea.